(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 054 568 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
22.11.2000 Bulletin 2000/47

(51) Int Cl.[7]: H04Q 3/00

(21) Application number: 00304241.3

(22) Date of filing: 19.05.2000

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: 20.05.1999 US 315170

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(54) Method and apparatus for providing a virtual SS7 link in a commmunications system

(57) A method, apparatus, and instructions for establishing a virtual communication channel (**508**) between applications on different nodes (**404** and **406**) in which one node may be using a communication protocol stack based on one protocol, such as SS7, and another node may be using a communication protocol stack based on another protocol, such as IP. Alternatively, a virtual communication channel (**508**) may be provided between applications on different nodes in which both nodes use a communication protocol stack based on IP to communicate with each other, but carry SS7 traffic through the communication channel (**508**). A gateway (**512**) is provided in which both SS7 and IP are supported. The gateway (**512**) allows for logical transport of signaling messages between peer applications on different nodes (**600** and **602**). Messages (**706**) for SS7 are placed in data packets (**700**) for transport to a destination using an IP connection or link to the destination. Header information (**704**) also is placed into the data packet (**700**) to allow for routing of the messages when the packet (**700**) is received at the destination.

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Printed by Jouve, 75001 PARIS (FR)

Description

1. Field of the Invention:

[0001] The present invention relates generally to data transport and in particular to a method and apparatus for sending and receiving messages between two nodes in a communications system.

2. Background of the Invention:

[0002] Signaling system number 7 (SS7) is a digital signaling standard developed by the International Telecommunication Union (ITU) - Telecommunications Standard Society (TSS). SS7 is the protocol for data communications in a communications system. In communications systems, a SS7 network is present, which is separate from the voice network. The SS7 network is used solely for the purpose of switching data messages pertaining to the business of connecting telephone calls and maintaining the signaling network. Common Channel Signaling (CCS) is the technology used in SS7 networks. CCS uses a digital facility, but places signaling information in a time slot or channel separate from the voice and data to which it is related. This mechanism allows signaling information to be consolidated and sent through its own network apart from the voice network. A packing switching system is the mechanism used for transferring messages throughout the network.

[0003] All nodes in a SS7 network are called "signaling points". A signaling point has an ability to perform message discrimination (read the address and determine if the address is for that node), as well as to route the SS7 messages to another signaling point. The main type of signaling points is a service switching point (SSP), which is a local exchange in a telephone network. A SSP may be a combination of a voice switch and a SS7 switch, or an adjunct computer connected to the local exchange's voice switch. The SSP provides the functionality of communicating with the voice switch via the use of primitives and creating packets, or signal units needed for transmission in a SS7 network. Another signaling point is a signal transfer point (STP), which serves as a router in the SS7 network. All SS7 packets travel from one SSP to another through the services of a STP. Another signaling point is a service control point (SCP), which serves as an interface to telephone company databases.

[0004] SS7 is used in cellular networks to provide signaling information required to establish and disconnect circuit connections, as well as share database information from one institute to another. A mobile switching center (MSC) in a communications system connects to the SS7 via a signaling transfer point. The SS7 network is instrumental in collocating all the cellular providers together and allowing their various databases to be shared with each other. For example, the home location register (HLR) is a database used to store information about users of a cellular network. A visitor location register (VLR) is a database used to store temporary subscriber information when that subscriber is visiting the coverage area. This information is retrieved from the subscriber's HLR. With SS7 signaling through a SS7 network, data stored in a HLR can be stored with other MSCs across the SS7 network.

[0005] With the rapid expansion of communication systems, such as cellular networks, the expansion of SS7 networks has been limited and regulated. Concerns about capacity of SS7 links and the cost associated with expanding and creating SS7 networks for communication systems has made the development and expansion of communication systems, such as cellular systems, costly. In addition, with increased traffic on SS7 networks, concerns regarding congestion and flow control are present.

[0006] Therefore, it would be advantageous to have an improved method and apparatus for transporting messages in a SS7 network.

SUMMARY OF THE INVENTION

[0007] The present invention overcomes congestion and flow concerns in signaling networks, such as SS7 networks, by providing a virtual communications link or connection between various nodes in a SS7 network. The virtual link is provided by gateways, which send SS7 messages over a network link, such as an Internet protocol link. The present invention provides a method, apparatus, and instructions for establishing a virtual communication channel between applications on different nodes in which one node may be using a communication protocol stack based on one protocol, such as SS7, and another node may be using a communication protocol stack based on another protocol, such as IP. Alternatively, a virtual communication channel may be provided between applications on different nodes in which both nodes use a communication protocol stack based on IP to communicate with each other, but carry SS7 traffic through the communication channel. A gateway is provided in which both SS7 and IP are supported. The gateway allows for logical transport of signaling messages between peer applications on different nodes. Messages for SS7 are placed in data packets for transport to a destination using an IP connection or link to the destination. Header information also is placed into the data packet to allow for routing of the messages when the packet is received at the destination.

[0008] The link or connection may be to another gateway or to a node, which extracts the message and header information from the data packet and sends it on to the appropriate node using the header information.

[0009] The mechanism of the present invention provides for internetworking addressing schemes between both SS7 and Transport Control Protocol/Internet Protocol (TCP/IP). In addition, the present invention allows for addition of nodes without requiring expansion of an

existing SS7 network.

[0010] The present invention provides a method in a network for transporting signaling data as claimed in claims 1 and 6; a signalling system as claimed in claim 11; a node as claimed in claim 22; a data processing system as claimed in claim 29 and claim 35 and a computer program as claimed in claims 40 and 41.

[0011] Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

Figure 1 is a diagram of a communications system depicted in accordance with a preferred embodiment of the present invention;

Figure 2 is a diagram of a SS7 network depicted in accordance with a preferred embodiment of the present invention;

Figure 3 is a block diagram of a data processing system, which may be implemented as a gateway, depicted in accordance with a preferred embodiment of the present invention;

Figure 4 is a diagram illustrating a SS7 gateway used as an interface between a SS7 network node and a SS7 network depicted in accordance with a preferred embodiment of the present invention;

Figure 5 is a diagram of a virtual SS7 link created by gateways depicted in accordance with a preferred embodiment of the present invention;

Figure 6 is a diagram illustrating the various components used in providing a virtual SS7 connection depicted in accordance with a preferred embodiment of the present invention;

Figure 7 is an illustration of a data packet sent over an IP network by a gateway depicted in accordance with a preferred embodiment of the present invention;

Figure 8 is a table of fields used in a gateway header depicted in accordance with a preferred embodiment of the present invention;

Figure 9 is a block diagram of data flow for a SCCP-IP unit depicted in accordance with a preferred embodiment of the present invention;

Figure 10 is a flowchart of a process used by a SCCP-IP in response to a request to establish a connection depicted in accordance with a preferred embodiment of the present invention;

Figure 11 is a flowchart of a process used in sending a message by a SCCP-IP depicted in accordance with a preferred embodiment of the present invention;

Figure 12 is a flowchart of a process for processing a message received from an IP network by a SCCP-IP depicted in accordance with a preferred embodiment of the present invention;

Figure 13 is a flowchart of a process for releasing a connection depicted in accordance with a preferred embodiment of the present invention;

Figure 14 is a block diagram of data flow in a gateway internetworking unit depicted in accordance with a preferred embodiment of the present invention;

Figure 15 is a flowchart of a process for receiving messages from an IP network by a gateway internetworking component depicted in accordance with a preferred embodiment of the present invention;

Figure 16 is a flowchart of a process used to receive SS7 messages depicted in accordance with a preferred embodiment of the present invention;

Figure 17 is a diagram of data flow in a SCCP-IP used in establishing a single connection between a gateway and a client depicted in accordance with a preferred embodiment of the present invention;

Figure 18 is a flowchart of a process for establishing a connection depicted in accordance with a preferred embodiment of the present invention;

Figure 19 is a process for sending messages depicted in accordance with a preferred embodiment of the present invention;

Figure 20 is a flowchart of a process for processing received messages depicted in accordance with a preferred embodiment of the present invention;

Figure 21 is a block diagram of data flow in a gateway internetworking unit depicted in accordance with a preferred embodiment of the present invention;

Figure 22 is a flowchart of a process for receiving messages depicted in accordance with a preferred embodiment of the present invention;

Figure 23 is a process for handling SS7 messages depicted in accordance with a preferred embodiment of the present invention;

Figure 24 is a flowchart of a process for encapsulating a message into a data packet depicted in accordance with a preferred embodiment of the present invention; and

Figure 25 is a flowchart of a process for extracting a message from a data packet depicted in accordance with a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] With reference now to the figures, and in par-

ticular with reference to **Figure 1**, a diagram of a communications system is depicted in accordance with a preferred embodiment of the present invention. Communications system **100** includes a voice network **102**, signaling network **104**, signaling network **106**, and an Internet protocol (IP) network **108**. Voice network **102** carries voice data for various calls within communications system **100**. In the depicted example, signaling network **104** and signaling network **106** are SS7 networks, which are separate from voice network **102** and are used for the purpose of switching data messages pertaining to call control signaling for telecommunications services within voice network **102**. Signaling network **104** uses a common channel signaling (CCS) in which a single channel conveys, by various labeled messages, signaling information relating to various circuits or other information such as that used for a network management.

[0014] In the depicted examples, messages are generated by a user or processor pertaining to call management within voice network **102** as part of the signaling in a signaling network, which is a set of transport facilities that carry signals. A SS7 network is a signaling network. Signaling network **104** and signaling network **106** are examples of a signaling network. Signaling is used to establish a connection, to monitor and supervise the status of the connection, and to terminate the connection. Signaling is the act of transferring this information between nodes. Signals, also referred to as signaling data, may include data signals, control signals, timing signals, but exclude voice. A data link is a connection between two nodes used to transfer signaling information between nodes. A data link as used herein excludes voice.

[0015] The present invention provides a mechanism in which messages using SS7 may be transferred outside of signaling network **104** to a node within signaling network **106**. The messages may be sent through IP network **108** through gateway **110** and gateway **112**. These gateways provide a mechanism for carrying messages from signaling network **104** to signaling network **106** in a manner that is transparent to various nodes within these SS7 networks. Gateways **110** and **112** may be used to connect two nodes over a standard transmission control protocol/Internet protocol (TCP/IP) used for data transmission of SS7 messages over networks, such as the Internet. IP is the protocol within TCP/IP that governs the breakup of data messages into packets, the routing of the packets from sender to destination network and station, and the reassembly of the packets into the original data messages at the destination. IP corresponds to the network layer in the ISO/OSI model. TCP is the protocol within TCP/IP that governs the breakup of data messages into packets to be sent via IP, and the reassembly and verification of the complete messages from packets received by IP. TCP corresponds to the transport layer in the ISO/OSI model.

[0016] Further, data may be transfer to other nodes within signaling network **104** through IP network **108**. This communications link is created through gateway **110** and gateway **114**. Messages within a node in signaling network **104** may be sent to another node in signaling network **104** using a communications link established through gateway **110** and gateway **114**. Messages are transferred through gateway **110** onto IP network **108** to gateway **114** and to another node within signaling network **104**. In this manner, additional expansion of signaling network **104** is unnecessary and communications links established between gateway **110** and gateway **114** may be used to transport data messages when congestion occurs within various points within signaling network **104**.

[0017] The use of IP network **108** to transport messages provides an advantage over current SS7 signaling because IP has a greater bandwidth. Currently, SS7 networks nominally have a 64K-transfer rate. In some cases, the rates may be 1.544 Mbps or 2.048 Mbps. IP networks can handle up to 100 Mbps. Further, extensive IP networks are present and available for use and do not require the same expense as expanding or creating SS7 networks.

[0018] For example, in typical SSP connection scenario, a mobile switching center (MSC) is connected to another MSC with STP functionality. In accordance with a preferred embodiment of the present invention, a TCAP encoded Mobile Application Part (MAP) message is wrapped in a special "SCCP-IP" header and transmitted over IP to an intermediate node. The intermediate node receives the payload, unwraps the "SCCP-IP" header, re-wraps it into a standard SCCP header and transmits it using Message Transfer Part (MTP) of SS7 to the destination node. The intermediate node may also transmit the message to an IP node with no modification. On this manner, the mechanism of the present invention may be used for peer to peer communication in a fashion similar to that in a SS7 network. The protocol can connect any client node to any SS7 node for connecting to the SS7 network. Further, the mechanism of the present invention may be used to connect a node that does not communicate over SS7 with a node within the SS7 network. With reference now to **Figure 2**, a diagram of a SS7 network is depicted in accordance with a preferred embodiment of the present invention. In this example, signaling network **200** is a SS7 network, which includes service-switching points (SSPs) **202-210**, signal transfer points (STPs) **212-218** and service control points (SCPs) **220-224**. An SSP is a local exchange in a telephone network and may be a combination of a voice switch and a SS7 switch, or an adjunct computer connected to a voice switch and the local exchange. SSPs provide the functionality of communicating with the voice switch via the use of primitives and creating packets, or signaling units, needed for transmission in signaling network **200**. SSP **208** and SSP **210** may establish a voice trunk between the two exchanges, but establish this trunk via a signaling path through STPs **214** and

216 within signaling network **200**.

[0019] A STP serves as a router in the SS7 network. A SCP serves as an interface to a database in the communications system. Databases are typically used to store information about subscriber services, routing and special service numbers, such as 800 and 900 numbers, calling card validation, and fraud protection. For example, a home location register (HLR) contains a database, which is found in cellular networks and is used to store information regarding a cellular subscriber. The HLR stores information regarding billing, services allowed, and the current location of the cellular phone. A visitor location register (VLR) is used to store data about a subscriber whenever the subscriber is registered in the area served by that MSC whether or not the subscriber is local. HLR data is always forwarded to the VLR. The HLR from which it gets the subscriber data may be local or remote. The VLR is used to store current locations for visiting subscribers. The VLR communicates this information to the HLR to allow the HLR to track subscriber locations. In the depicted examples, VLR and HLRs are colocated with a MSC and are also SSPs.

[0020] In addition, signaling network **200** also includes gateways **226** and **228**, which may be used as an alternative path to connect SCP **222** to STP **216**. Alternatively, gateways **226** and **228** may be used to form a connection between STP **216** and STP **218**. Gateway **228**, may provide a connection between STP **218** and SCP **224**, which is a SCP not normally connected to signaling network **200**. Gateway **228** provides a connection between STP **218**, which communicates using SS7 while SCP **224** is accessed using another protocol, such as IP. Computers are used at these signaling points to perform signaling functions.

[0021] Referring to **Figure 3**, a block diagram of a data processing system, which may be implemented as a gateway, is depicted in accordance with a preferred embodiment of the present invention. Data processing system **300** may be used to implement gateways, such as gateways **110**, **112**, and **114** in **Figure 1** or gateways **226** and **228** in **Figure 2**.

[0022] Data processing system **300** may be a symmetric multiprocessor (SMP) system including processors **302** and **304** connected to system bus **306**. Alternatively, a single processor system may be employed. Also connected to system bus **306** is memory controller/cache **308**, which provides an interface to local memory **309**. I/O bus bridge **310** is connected to system bus **306** and provides an interface to I/O bus **312**. Memory controller/cache **308** and I/O bus bridge **310** may be integrated as depicted.

[0023] Peripheral component interconnect (PCI) bus bridge **314** connected to I/O bus **312** provides an interface to PCI local bus **316**. A number of modems may be connected to PCI bus **316**. Typical PCI bus implementations will support four PCI expansion slots or add-in connectors. Communications links to other computers or nodes in signaling network **104**, signaling network **106** or IP network **108** in **Figure 1** may be provided through network adapter **318** and network adapter **320** connected to PCI local bus **316** through add-in boards. Network adapter **318** may provide communications with a SS7 network while network adapter **320** may provide communication with an IP network.

[0024] Additional PCI bus bridges **322** and **324** provide interfaces for additional PCI buses **326** and **328**, from which additional modems or network adapters may be supported. In this manner, server **300** allows connections to multiple nodes on different networks. A memory-mapped graphics adapter **330** and storage unit **332** may also be connected to I/O bus **312**, either directly or indirectly. Storage unit **332** may be implemented in a number of ways. For example, storage unit **332** may be a hard disk or an array of hard disks. Additionally, storage unit **332** may be a heterogeneous storage system containing devices, such as hard disks, DVD drives, and tape drives. With this system, the process of the present invention may be executed by processors **302** and **304** through instructions and data located in local memory **309** and storage unit **332**.

[0025] Those of ordinary skill in the art will appreciate that the hardware depicted in **Figure 3** may vary. For example, other peripheral devices, such as optical disk drives and the like, also may be used in addition to or in place of the hardware depicted. The depicted example is not meant to imply architectural limitations with respect to the present invention.

[0026] With reference now to **Figure 4**, a diagram illustrating a gateway used as an interface between a SS7 network node and a SS7 network is depicted in accordance with a preferred embodiment of the present invention. In this example, MSC/VLR **400** may communicate with SS7 node **404** through switch **406**. Link interface unit (LIU) **408** and link interface unit (LIU) **410** are used to establish SS7 link **412**. Messages may be sent to SS7 node **404** via gateway **414**, which establishes an IP link **416** with node **404** in this example. Node **404** may be connected to a SS7 network (not shown).

[0027] Turning next to **Figure 5**, a diagram of a virtual SS7 link created by gateways is depicted in accordance with a preferred embodiment of the present invention. In this example, MSC/VLR **500** may register information from mobile station **502**, which is in the area managed by MSC/VLR **500**. Mobile station **502** is a visitor in this area and information about mobile station **502** is stored within VLR **500**. In addition, information is sent to HLR **506** so that HLR **506** may track the location of mobile station **502**. In the depicted example, this information is sent over virtual SS7 link **508**, which is an IP link carrying SS7 traffic using IP packets. Virtual SS7 link **508** is established between SS7 gateway **510** and SS7 gateway **512**. SS7 messages are encapsulated in IP packets for transport over virtual SS7 link **508**. In this instance, virtual SS7 link **508** acts as a high-capacity traffic tunnel for carrying SS7 traffic between MSC/VLR **500** andHLR **506**. This link may be used when current bandwidth

within a SS7 network is insufficient to support applications like LNP or due to the number of subscribers. Alternatively, the virtual SS7 link may be used as a permanent connection to carry SS7 traffic. In this manner, peer to peer communication in a fashion similar to that on a SS7 network may be provided. Thus, the present invention allows for expansion of SS7 message transport when current SS7 networks are at capacity using a less costly infrastructure.

[0028] Turning now to **Figure 6**, a diagram illustrating the various components used in providing a virtual SS7 connection is depicted in accordance with a preferred embodiment of the present invention. In this example, a node **600** may exchange messages with another node **602** through a gateway **604**. In this example, node **600** is connected to a SS7 network, while node **602** is connected to an IP network. Node **600** may be a node, such as MSC/VLR **406** in **Figure 4**, while node **602** may be an SS7 node, such as SS7 node **404** in **Figure 4**. In such an instance, a IP link, such as IP link **416**, is the connection used to carry traffic between node **602** and node **604**, while communications between node **600** and **604** may be established through an SS7 link, such as SS7 link **412** in **Figure 4**.

[0029] Gateway **604** provides a bridge between the SS7 network and the IP network and provides the mechanism to allow transfer of SS7 messages between node **600** and node **602**. Application **606** in this example is a short message service (SMS).In this example, the message is sent by application **608** using mobile application part (MAP) **610**, which in this example is used for a global system for mobile communications (GSM) wireless network. MAP is used in cellular networks to provide a mechanism by which cellular subscriber information may be passed from one cellular network to another. Transaction capabilities application part (TCAP) **614** is a protocol is an encoding scheme used to allow peer applications to establish, maintain, and terminate messaging dialogs. TCAP **614**'s functions include functions, such as those required to connect to an external database, perform a query of the database, and retrieve information. In this example, no changes to software or protocol layers are required in the SS7 nodes. All functionality for transporting data between SS7 and IP networks is provided through the gateway. The information or data retrieved is then sent back in the form of a TCAP message to the node requesting the information. TCAP also supports remote control of other entities within a SS7 network.

[0030] Node **600** communicates using SS7 protocols. In particular, node **600** includes signaling connection control part (SCCP) **618**. SCCP **618** is a protocol used for accessing remote applications and other entities. SCCP **618** provides the address necessary to route a message to the correct application, such as, for example, a database. These addresses are also called subsystem numbers and are logical addresses used by the protocols to route a message to the appropriate application entity. SCCP **618** also is considered part of layer 3 in an International Organization for Standardization Open Systems Interconnect (ISO/OSI) model. SCCP **618** relies on the services of a message transfer part (MTP), which acts as a carrier for all SS7 messages to provide reliable transfer of messages from one signaling point to another signaling point. In this example, MTP includes message transfer part level 3 (MTP3) **620**, message transfer part level 2 (MTP2) **622**, and message transfer part level 1 (MTP1) **624**. The MTP provides the same functionality as layers 1, 2, and 3 in the ISO/OSI model. These layers are the physical, data link, and network layers in OSI. SCCP **618** provides a means for end to end routing while MTP is capable of only point to point routing. As a result, a message can be routed only on the physical links available from a signaling point. SCCP **618** provides addressing to route a message through the entire network with this information being used by each signaling point by MTP3 **620** to determine which link set to use. MTP2 **622** provides functions necessary to provide error detection and correction for signaling units. MTP1 **624** is a physical layer, which allows for the use of any digital type interface supporting the data rate required by the network. MTP3 **620** provides for message routing, message discrimination, message distribution, and network management.

[0031] In contrast, node **602** communicates using an IP protocol. Node **602** includes a SCCP-IP **626**, which defines a mechanism for establishing and maintaining connections for the application on the TCP/IP stack and provides an interface for message transport. Transmission control protocol (TCP) **628** and Internet protocol (IP) **630** form the protocol that governs the breakup of data messages into packets to be sent via IP and the reassembling and verification of the complete messages from packets received by IP. TCP **628** corresponds to a transport layer in the ISO/OSI model, while IP **630** corresponds to the network layer within the ISO/OSI model. Ethernet **632** provides the physical interface for transmitting data over an IP network. Of course, the data may be transferred by another mechanism used to communicate over an IP network.

[0032] Gateway **604** includes the necessary components to communicate with both types of networks. In particular, gateway **604** includes SCCP **634**, MTP3 **636**, MTP2 **638**, and MTP1 **640**, which are used to provide communications with a SS7 network. In addition, gateway **604** also includes SCCP/IP **642**, TCP **644**, IP **646**, and Ethernet **648** which provide the components necessary to communicate on an IP network. TCAP can either be connection oriented or connectionless. MAP makes use of mainly the connection oriented capabilities of TCAP. SCCP can be either connection oriented on connectionless. MAP/TCAP mainly uses the connectionless facilities of SCCP. TCAP is used to provide the connection to the MAP protocol. The SCCP-IP components illustrated in **Figure 6** provide connection management with the TCP components. In addition, SCCP

header encoding and decoding is provided by this particular component. Also, this component provides an application program interface to the application, such as application **608**.

[0033] Internetworking **650** is a gateway TCP message handling mechanism that provides for receiving and sending of TCP messages. Internetworking **650** provides the mechanism used to place SS7 messages into an IP packet and to remove SS7 from IP packets. In addition, internetworking **650** allows for SS7 message handling. Internetworking **650** provides signaling message internetworking along with SS7 to TCP connection maintenance internetworking, such as error control, congestion control, and connection status propagation. A pair of gateways, such as gateway **604**, may be used to provide a virtual SS7 link between two nodes that communicate using SS7. Alternatively, a single gateway is sufficient depending on the implementation. TCAP **614** is a mechanism that provides transaction management with its peer TCAP **616**, both of which serve the MAP application SMS (**606** and **608**) in this example. TCAP **614** and TCAP **616** communicate using the communication protocol and mechanism described in the previous paragraphs.

[0034] With reference now to **Figure 7**, an illustration of a data packet sent over an IP network by a gateway is depicted in accordance with a preferred embodiment of the present invention. Data packet **700** includes a header **702**, which is a standard 8 byte IP header. The payload area of data packet **700** contains a short gateway header **704**, which is 34 bytes in this example. In the depicted example, gateway header **704** is a header for a short message service (SMS) MAP message. In addition, a message **706** is contained within the payload of data packet **700**. In this example, message **706** is a SMS MAP message. This message is a variable TCAP message in the depicted example.

[0035] Turning next to **Figure 8**, a table of fields used in a gateway header is depicted in accordance with a preferred embodiment of the present invention. Table **800** depicts data that may be used in SMS gateway header **704** in data packet **700**. These fields within gateway header **704** are used to process the message within the IP packet when the IP packet is received by a gateway. In the depicted example, these fields are used with a short message service (SMS) as well as with other protocols. The gateway header is application independent. The fields are used to place the message within the IP packet with the gateway header containing the information necessary to extract the message from the packet and then route it on to the destination. In particular, gateway header **704** in **Figure 7** would include a network type **802**, a protocol version **804**, a universal data type (UDT) data format **806**, a sequence control **808**, SCCP class **810**, return information **812**, called party address **814**, calling party address **816**, spare **818**, and data length **820**.

[0036] Network type **802** provides information as to how the message is encoded. This field provides an indication of the network to which the message is being transferred. Protocol version **804** is used to correspond implementations of the protocol between the gateway and the remote application. UDT data format **806** is a field that provides a data format for decoding of messages. Sequence control **808**, SCCP class **810**, return information **812**, calling party address **816**, and data length **820** are fields that are normally found in a SCCP header.

[0037] The information in the gateway header as illustrated in table **800** is selected as a minimal set of information from SCCP header information that is available in a SS7 node at either end of the connection created by a gateway. The amount of information within the gateway header is selected to be sufficient to allow a SS7 node to continue routing the message associated with the gateway header.

[0038] The gateway may provide connections to one or more clients over an IP link. The gateway maintains a table of addresses used to translate an SS7 address of a SS7 node to form an IP address. In essence, the gateway acts as a multiplexer in which the chosen representation is a session on the gateway that uniquely identifies each connection. The sessions are required for all TCP connections as well as clients or SS7 nodes registered to the gateway. The implementation described in **Figures 9-16** refers to an implementation in which the SCCP-IP acts both as a sever and client. In **Figure 17-25**, the implementation depicted is one in which the SCCP-IP is always only a server on the gateway.

[0039] In **Figure 9**, a block diagram of data flow for a SCCP-IP unit is depicted in accordance with a preferred embodiment of the present invention. SCCP-IP **900** may be implemented either in SCCP-IP **642** in gateway **602** or in SCCP-IP **626** in node **604** in **Figure 6**. SCCP-IP **900** interfaces between an application and an IP network. The application may be an application, such as application **608** in node **602** or internetworking **650** in gateway **604**. SCCP-IP **900** may both act as a server and a client. The gateway has knowledge of SCCP-IP applications, which are transaction oriented and a connection is established at either end for a new TCAP transaction. In this instance, SCCP-IP is a server on the gateway and a client on the application.

[0040] SCCP-IP **900** may receive, connect, disconnect, and send message requests from an application. These request translate into TCP connect, TCP close, and send message requests that are sent on to an IP network by SCCP-IP **900**. In response to receiving a message from the IP network, SCCP-IP **900** will send a received message to the application. In response to establishing a connection, SCCP-IP **900** may send the application connection status information. Errors also may be sent to the application by SCCP-IP **900**.

[0041] The figures and flowcharts **10-13** illustrate processes employed by SCCP-IP **900** in **Figure 9**.

[0042] With reference now to **Figure 10**, a flowchart of a process used by SCCP-IP **900** in response to a request to establish a connection is depicted in accordance with a preferred embodiment of the present invention. The process begins by receiving a connection request from the application (step **1000**). Thereafter, a determination is made as to whether the request contains a global title (GT) translation or point code (PC) and subsystem number (SSN) (step **1002**). The request made by the application for a connection is made by providing either a SCCP address either as a global title or a point code and subsystem number. When the address is a global title, such as an 800 number, then a global title translation is performed to obtain the point code and subsystem number (step **1004**).

[0043] Thereafter, the point code and subsystem number is used to determine the gateway server address (step **1006**). This process proceeds directly to this step from step **1002** if the request includes a point code and subsystem number. Step **1006** provides an IP address for the gateway server. Global title translation is a standard SS7 function that may be used to change signaling addresses to obtain a destination, which is identified by the point code, and an application at the destination, which is identified by the subsystem number. This information is preset for particular destinations. The identification may be made by interrogating a database containing the appropriate IP address for a particular point code and subsystem number.

[0044] Next, a TCP socket is opened with a keep-alive option (step **1008**). In the depicted example, the keep-alive option is used to maintain the connection after establishment of the connection. In these examples the option is part of the IP protocol. This keep-alive option may be implemented in a number of ways depending on the design. For example, a timer may be set to a number of seconds on both ends of the communications link and on the expiration of the timer, each side will register the length as out of service and start a recovery procedure and repeat the procedure until successful. Detection of traffic on the length may cause the timer to be reset without expiring.

[0045] Then, a connection is made to a SS7 gateway server (step **1010**). This connection is performed using known IP connection processes to send a message and receive a response to the message in the form of an acknowledgement. In response to a connection being made with the gateway server, then the socket is recorded against the transaction ID (step **1012**) with the process terminating thereafter. In this instance, the point code and subsystem number is recorded along with the socket to allow translating a connection from SS7 to IP. At this point, a connection has been established.

[0046] With reference now to **Figure 11**, a flowchart of a process used in sending a message by a SCCP-IP is depicted in accordance with a preferred embodiment of the present invention. This process is used to transport SS7 messages, such as a message encoded using TCAP rules. The process begins by receiving a message from the application (step **1100**). The message is encoded according to TCAP encoding rules. Upon receiving the message from the application, a gateway header is encoded and the message from the application also is encoded as data into a packet for transport on the IP network (step **1102**). Thereafter, the encoded message is sent (step **1104**). This encoded message is an IP data packet, such as data packet **700** in **Figure 7**.

[0047] With reference now to **Figure 12**, a flowchart of a process for processing a message received from an IP network by a SCCP-IP is depicted in accordance with a preferred embodiment of the present invention. This process is used to process messages received from an IP network by the SCCP-IP. The process begins by receiving a message (step **1200**). This message is in the form of a data packet used for transport on an IP network. The gateway header is decoded and the message is extracted from the data field in the data packets (step **1202**). Thereafter, the message is sent to the application (step **1204**) with the process terminating thereafter.

[0048] Turning next to **Figure 13**, a flowchart of a process for releasing a connection is depicted in accordance with a preferred embodiment of the present invention. The process begins by receiving requests to disconnect connection (step **1300**). Thereafter, the TCP connection is closed with the far end identified by the TCP socket (step **1302**). Then, the socket is released along with transaction resources used in maintaining the socket (step **1304**) with the process terminating thereafter.

[0049] Turning next to **Figure 14**, a block diagram of data flow in a gateway internetworking unit is depicted in accordance with a preferred embodiment of the present invention. In this example, gateway internetworking **1400** may well send messages between a SS7 network and an IP network. Gateway internetworking **1400** may receive SS7 messages and SCCP management (SCMG) messages from a SS7 network. Gateway internetworking **1400** may send SS7 messages and also send SCMG messages to a SS7 network. In addition, gateway internetworking **1400** may connect and close TCP connections along with sending messages onto the IP network as well as received messages from the IP network.

[0050] The flowcharts in **Figures 15** and **16** illustrate processes used by gateway internetworking **1400** in **Figure 14**.

[0051] With reference now to **Figure 15**, a flowchart of a process for receiving messages from an IP network by a gateway internetworking component is depicted in accordance with a preferred embodiment of the present invention. This process is used to identify connections to another node or gateway on the IP network. The process begins by receiving an IP message (step **1500**). Thereafter, the gateway header is decoded and the message is extracted from the data field of the IP mes-

sage (step **1502**). A determination is then made as to whether a transaction ID has been recorded for this message (step **1504**). If a transaction ID has not been recorded, then a transaction ID is recorded against the TCP socket (step **1506**). The determination is made by querying a database of connections for known sockets to see if the transaction ID is associated with the particular socket. If the transaction ID has been recorded, then after the recording of the transaction ID a SCCP header is encoded (step **1508**) and a SS7 message is then sent (step **1510**) with the process terminating thereafter.

[0052] With reference now to **Figure 16**, a flowchart of a process used to receive SS7 messages is depicted in accordance with a preferred embodiment of the present invention. The process begins by receiving a SS7 message (step **1600**). Thereafter, a determination is made as to whether the subsystem number (SSN) in the message is equal to zero (step **1602**). A zero would indicate that a SCMG message has been received. If this determination is yes, then a determination is made as to whether the message is a subsystem test (SST) message (step **1604**). A subsystem test message is used to inquire whether a remote peer SCCP application is available.

[0053] If the message is a subsystem test message then the point code and subsystem number are used to determine an SS7 application server address (step **1606**). A determination is then made as to whether the maintenance connection is active (step **1608**). If the maintenance connection is active, then a subsystem allowed message (SSA) is sent for the particular subsystem number as a SCMG message (step **1610**) with the process terminating thereafter. If the connection is not alive, the SSP for the SSN is sent (step **1611**) with the process then terminating. In SS7, subsystem number zero is a reserved number that corresponds to a SCCP management SCMG message.

[0054] With reference again to step **1604**, if the determination made as to whether the message is a subsystem test message is no, then the process determines whether the message is a subsystem allowed message (step **1612**). This determination is used to handle non-SST subsystem messages. If the message is a subsystem allowed message, the process then marks the point code and subsystem number as being available at the remote SS7 node (step **1614**) with the process terminating thereafter. Otherwise, the point code subsystem number is marked as being prohibited or unavailable at the remote SS7 node (step **1616**) with the process terminating thereafter.

[0055] With reference again to step **1602**, if the subsystem number is not equal to zero, then the SCCP header is decoded (step **1618**). A determination is then made as to whether a global title or a point code is contained within the header (step **1620**). If a global title (GT) is present, then a global title translation is performed to obtain a SS7 point code (step **1622**). Thereafter, the point code and subsystem number are used to determine a SS7 application server address (step **1624**). With reference again to step **1620**, if a point code is present, the process proceeds directly to step **1624**.

[0056] Next, a determination is made as to whether a transaction ID has been recorded for this particular socket (step **1626**). If a transaction ID has not been recorded, the process then opens a TCP socket with a keep-alive option (step **1628**). Thereafter, a connection is made with the application server (step **1630**).

[0057] When the connection has been established, a SCCP-IP header is encoded along with the application message being placed in a data packet as data (step **1632**). Thereafter, the encoded message is sent resulting in the sending of the message on the IP network (step **1634**) with the process terminating thereafter.

[0058] With reference to step **1626**, if a transaction ID has been recorded, the process then proceeds to step **1632** as described above.

[0059] **Figures 17-25** illustrate and embodiment in which the SCCP-IP is always a server on the gateway. Next in **Figure 17**, a diagram of data flow in a SCCP-IP used in establishing a single connection between a gateway and a client is depicted in accordance with a preferred embodiment of the present invention. SCCP-IP **1700** may receive a message to be sent from an application. In addition, SCCP-IP may open and close TCP connections along with sending messages to the IP network on opened TCP connections. SCCP-IP may receive messages on the connection and send the message on to an application in addition to providing the application with the connection status and identification of errors.

[0060] The processes illustrated in **Figures 18-20** are those used by an SCCP-IP in establishing a single connection. In addition, this single connection may be established between two gateways.

[0061] With reference now to **Figure 18**, a flowchart of a process for establishing a connection is depicted in accordance with a preferred embodiment of the present invention. The process begins by finding a server address for the particular point code and subsystem number combination (step **1800**). Thereafter, a TCP socket for the server address is opened with the keep-alive option (step **1802**). Thereafter, a connection is made with the SS7 gateway server (step **1804**). The socket is recorded with the point code and subsystem number (step **1806**). Thereafter, a determination is made as to whether additional point code and subsystem number combinations are present for processing (step **1808**). If additional point code and subsystem number combinations are present for processing, the process then returns to step **1802**. Otherwise, the process terminates.

[0062] With reference now to **Figure 19**, a process for sending messages is depicted in accordance with a preferred embodiment of the present invention. This figure illustrates the process used by SCCP-IP **1700** in **Figure**

17 to send messages received from an application. The process begins by receiving a message from the application to be sent to a destination (step **1900**). The message received is an encoded message from the application. The message is encoded using TCAP encoding rules. In addition, an SCCP address is provided either as a global title or point code and SCCP subsystem number. In step **1902**, a determination is made as to which type of address has been provided. If the address is a global title, then a global title translation is performed to obtain the SS7 point code (step **1904**). The process then uses the point code and subsystem number to identify a gateway server address (step **1906**). The process proceeds directly to step **1906** from step **1902** if the address provided by the application is a point code. Next, the SCCP-IP header is encoded along with decoding the application message as data within a data packet for transport on an IP network (step **1908**). Thereafter, the decoded message is then sent to the IP network (step **1910**) with the process terminating thereafter.

[0063] Turning to **Figure 20**, a flowchart of a process for processing received messages is depicted in accordance with a preferred embodiment of the present invention. This flowchart is used to describe the processing of messages received from an IP network. The process begins by receiving a message (i.e., IP data packet) from the IP network (step **2000**). Thereafter, the gateway header is decoded and the message is extracted from the data field of the data packet received from the IP network (step **2002**). Thereafter, the message is forwarded to the application (step **2004**) with the process terminating thereafter.

[0064] With reference now to **Figure 21**, a block diagram of data flow in a gateway internetworking unit is depicted in accordance with a preferred embodiment of the present invention. Gateway internetworking unit **2100** may receive SS7 messages and SCCP management messages from a SS7 network. In response, gateway internetworking unit **2100** may send IP messages onto the IP network. In addition, IP messages may be received and sent to destinations on the SS7 network. Also, TCP connect and TCP close request may be received by gateway internetworking unit **2100**.

[0065] In **Figure 22**, a flowchart of a process for receiving messages is depicted in accordance with a preferred embodiment of the present invention. The process begins by receiving an IP data packet from the IP network (step **2200**). Thereafter, the gateway header is decoded and the message is extracted from the data field of the IP data packet received from the IP network (step **2202**). A determination is then made as to whether the address is a global title or point code and subsystem number address (step **2204**). If the address is a global title address, a global title translation is performed to derive a SS7 point code address (step **2206**). Thereafter, the process encodes a SS7 SCCP header (step **2208**). The process also proceeds directly to step **2208** from step **2204** if the address has a point code address. Next, a message is sent to the node identified by the point code and subsystem number (step **2210**) with the process terminating thereafter.

[0066] With reference now to **Figure 23**, a process for handling SS7 messages is depicted in accordance with a preferred embodiment of the present invention. The process begins by receiving a SS7 message (step **2300**). Thereafter, a determination is made as to whether the subsystem number in the message is equal to zero (step **2302**). A zero would indicate that a SCMG message has been received. If this determination is yes, then a determination is made as to whether the message is a subsystem test (SST) message (step **2304**). If the message is a subsystem test message then the point code and subsystem number are used to determine a SS7 application server address (step **2306**). A determination is then made as to whether the connection is alive (step **2308**). If the connection is alive, then a subsystem allowed message is sent for the particular subsystem number as a SCMG message (step **2310**) with the process terminating thereafter. If the connection is not alive in step **2308**, the SSP for the SSN is sent (step **2311**) with the process then terminating. In SS7, subsystem number zero is a reserved number that corresponds to a SCCP management (SCMG) message. A subsystem test message is used to verify that a connection is present between peer SCCP and applications, send a message between peers to establish a connection in this example.

[0067] With reference again to step **2304**, if the SS7 message is not a subsystem test message, a determination is made as to whether the message is a subsystem allowed (SSA) message (step **2312**). If the message is a subsystem allowed message, the process then marks the point code and subsystem number as being available at the remote SS7 node (step **2314**) with the process terminating thereafter. Otherwise, the point code and subsystem number is marked as being prohibited or unavailable at the remote SS7 node (step **2316**) with the process terminating thereafter.

[0068] With reference again to step **2302**, if the SCCP subsystem is not equal to zero, then the SS7 message is parsed and the SCCP header is decoded (step **2318**). Thereafter, a determination is made as to whether the header includes a global title or point code address (step **2320**). If the address is a global title, the process then performs a global title translation to obtain the SS7 point code (step **2322**). Thereafter, the point code and subsystem number are used to determine a SS7 application server address (step **2324**).

[0069] With reference again to step **2320**, if the address is a point code address, the process proceeds to step **2324** as described above. Next, a gateway header is encoded along with the application message into the data field of an IP data packet (step **2326**). The encoded messages are then sent on the connection established for the particular IP nodes (step **2328**) with the process

terminating thereafter.

[0070] In **Figure 24**, a flowchart of a process for encapsulating a message into a data packet is depicted in accordance with a preferred embodiment of the present invention. This process is used to create data packets for transport on an IP network using messages designed for transport on a SS7 network. The process begins by receiving a message that is to be sent over an IP connection (step **2400**). A gateway header is created for the message (step **2402**). This gateway header contains information such as that found in table **800** in **Figure 8**. A destination on the IP network is identified for the message (step **2404**). This destination is in the form of an IP address. With this IP address, a data packet header is created for the data packet (step **2406**). Thereafter, the gateway header and message are placed into the payload of the data packet (step **2408**) with the process terminating thereafter.

[0071] With reference now to **Figure 25**, a flowchart of a process for extracting a message from a data packet is depicted in accordance with a preferred embodiment of the present invention. This process begins by receiving a data packet (step **2500**). The gateway header and message are extracted from the payload portion of the data packet (step **2502**). With the information from the gateway header, a SCCP address is formatted (step **2504**) with the process terminating thereafter. At this point, the message may be routed to the appropriate node or application using the SCCP address. This message may be placed into existing SCCP interfaces in the SS7 network for routing.

[0072] It is important to note that while the present invention has been described in the context of a fully functioning data processing system, those of ordinary skill in the art will appreciate that the processes of the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention applies equally regardless of the particular type of signal bearing media actually used to carry out the distribution. Examples of computer readable media include recordable-type media such a floppy disc, a hard disk drive, a RAM, and CD-ROMs and transmission-type media such as digital and analog communications links.

[0073] The description of the present invention has been presented for purposes of illustration and description, but is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. For example, although the depicted examples illustrate the use of TCP in handling the transport of messages over an IP link, other protocols also may be used, such as universal datagram protocol (UDP). UDP is a connectionless protocol within TCP/IP that corresponds to the transport layer in the ISO/OSI model. UDP converts data messages generated by an application into packets to be sent via IP but does not verify that messages have been delivered correctly. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.

Claims

1. A method in a network for transporting signaling data between a first node and a second node in the network, wherein signaling data is transmitted within the network using a first protocol, the method comprising:

   receiving signaling data for transfer from the first node to the second node using the first protocol;
   placing the signaling data into a data packet for transport using a second protocol;
   establishing a communications link between the first node and the second node using a second protocol; and
   sending the data packet from the first node to the second node using the second protocol.

2. The method of claim 1 further comprising:
   placing routing information into the data packet, wherein the routing information is used to process the signaling data at the second node.

3. The method of claim 2 further comprising:

   receiving a new data packet;
   extracting the signaling data and the routing information from the new data packet; and
   routing the signaling data using the routing information.

4. The method of claim 1, wherein the steps of receiving, placing and sending are performed by a gateway.

5. The method of claim 1, wherein the first protocol is a SS7 protocol and the second protocol is an Internet protocol.

6. A method for transferring signaling data within a network, the method comprising:

   receiving a message for transfer to a node, wherein the message is received using a first protocol;
   placing the message in a data packet using a second protocol to create the data packet;
   placing routing information into the data packet, wherein the routing information is used by the

first protocol for processing of the packet at the node;
establishing a connection to the node, wherein the connection uses the second protocol to send data packets; and
sending the data packet to the node through the connection.

7. The method of claim 6 further comprising:

receiving a data packet, wherein the data packet is a received data packet containing a message and routing information;
extracting the message and routing information from the received data packet; and
processing the message using the routing information.

8. The method of claim 7, wherein processing comprises:
sending the message to a node based on the routing information

9. The method of claim 6, wherein the first protocol is a SS7 protocol and the second protocol is an Internet protocol.

10. The method of claim 6 or claim 1, wherein the first protocol is a connectionless protocol and wherein the second protocol is a connection oriented protocol

11. A signaling system comprising:

a signaling network, wherein the signaling network is used to manage connections within a communications network, wherein the message used to manage connections are transported within the signaling network using a first protocol;
a first gateway connected to the signaling network, wherein the gateway receives a message used to manage connections, places the message in a data packet, transports the message over a connection governed by a second protocol; and
a second gateway in communication with the first gateway using the connection, wherein the second gateway receives the data packet, extracts the message form the data packet, and sends the message to a destination using the first protocol.

12. The signaling system of claim 11, wherein the signaling network is a SS7 network.

13. The signaling system of claim 12, wherein the connection uses an Internet protocol to transfer the data packet.

14. The signaling system of claim 13, wherein the gateway includes:

a signaling connection control part and a message transfer part used to communicate with the SS7 network;
a transmission control protocol and a Internet protocol used to communicate with the gateway;
first processing means for placing messages into data packets for transport using the second protocol; and
second processing means for extracting messages from data packets for transport using the first protocol.

15. The signaling system of claim 14, wherein the first processing means comprises:

determining means for determining an Internet protocol address from a signaling connection control part address;
first creating mean for creating a gateway header containing data used to recreate the signaling connection control part address; and
placing means for placing the message and the gateway header into a data packet; and
second creating means for creating a header of the data packet using the Internet protocol address.

16. The signaling system of claim 15, wherein the signaling connection control part address includes a point code and a subsystem number.

17. The signaling system of claim 11, wherein the signaling network includes a plurality of signaling points and wherein the first gateway and the second gateway provide a data channel between a plurality of signaling points within the signaling network.

18. The signaling system of claim 11, wherein the second protocol is a transport control protocol.

19. The signaling system of claim 11, wherein the second protocol is user datagram protocol.

20. The signaling system of claim 11, wherein the second gateway is connected to the signaling network and wherein the destination is a node in the signaling network.

21. The signaling system of claim 11, wherein the destination is a node external to the signaling network.

22. A node comprising:

a signaling connection control part and a message transfer part used to communicate with a SS7 network, wherein messages are routed within the SS7 network using a signaling connection control address;
a transmission control protocol and a Internet protocol used to communicate with the gateway;
first processing means for placing messages into data packets for transport using the second protocol; and
second processing means for extracting messages from data packets for transport using the first protocol.

23. The node of claim 22, wherein the first processing means includes:
placing means for placing routing information into the data packets in association with the messages.

24. The node of claim 23, wherein the second processing means includes:

extraction means for extracting the routing information from the data packets; and
routing means for routing the messages using the routing information.

25. The node of claim 22, wherein the first processing means comprises:

creating a header containing data used to recreate the signaling connection control part address; and
placing the message and the header into a data packet.

26. The node of claim 25 further comprising:

determining means for determining an Internet protocol address from the signaling connection control part address; and
connection means for creating a connection using the Internet protocol address, wherein the connection is used to send data packets using the second protocol.

27. The node of claim 22, wherein the node is a signaling point in a SS7 network.

28. The node of claim 22, wherein the node is a gateway.

29. A data processing system in a network for transporting signaling data between a first node and a second node, the data processing system comprising:

receiving means for receiving signaling data for transfer from the first node to the second node using a first protocol;
placing means for placing the signaling data into a data packet for transport using a second protocol;
establishing means for establishing a communications link between the first node and the second node using a second protocol; and
sending means for sending the data packet from the first node to the second node using the second protocol.

30. The data processing system of claim 29 further comprising:
placing means for placing routing information into the data packet, wherein the routing information is used to process the signaling data at the second node.

31. The data processing system of claim 30 further comprising:

receiving means for receiving a new data packet at the second node;
extracting means for extracting the signaling data and the routing information from the new data packet; and
routing means for routing the signaling data from the second node using the routing information.

32. The data processing system of claim 29, wherein the receiving means, placing means and sending means are performed by a gateway.

33. The data processing system of claim 29 or the method of claim 1, wherein the first node and the second node are gateways.

34. The data processing system of claim 29 or the method of claim 1, wherein the first node is a gateway and the second node is a signaling point in a SS7 network.

35. A data processing system for transferring signaling data within a network, the data processing system comprising:

receiving means for receiving a message for transfer to a node, wherein the message is received using a first protocol;
first placing means for placing the message in a data packet using a second protocol to create the data packet;
second placing means for placing routing information into the data packet, wherein the routing information is used by the first protocol for

processing of the packet at the node;
establishing means for establishing a connection to the node, wherein the connection uses the second protocol to send data packets; and
sending means for sending the data packet to the node through the connection.

36. The data processing system of claim 35 further comprising:

receiving means for receiving a data packet, wherein the data packet is a received data packet containing a message and routing information;
extracting means for extracting the message and routing information from the received data packet; and
processing means for processing the message using the routing information.

37. The data processing system of claim 36, wherein the processing means comprises:
sending means for sending the message to a node based on the routing information

38. The data processing system of claim 35 or the method of claim 6, wherein the first protocol is a SS7 protocol.

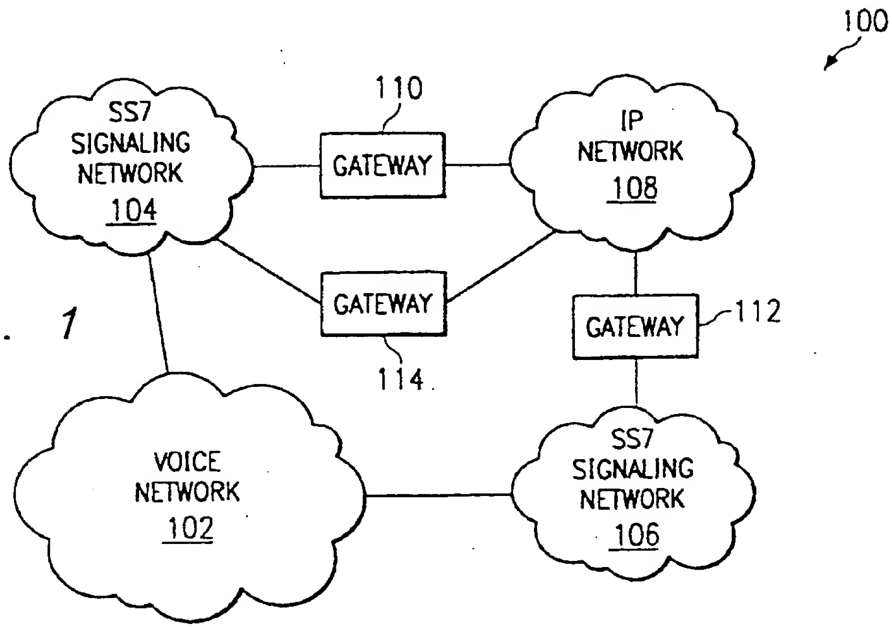
39. The data processing system of claim 35 or the method of claim 6, wherein the method is executed in a signaling point in a signaling network.

40. A computer program product for use in transporting data in a communications system, the computer program product comprising:

first instructions for receiving signaling data for transfer from the first node to the second node using a first protocol;
second instructions for placing the signaling data into a data packet for transport using a second protocol;
third instructions for establishing a connection between the first node and the second node; and
fourth instructions for sending the data packet from the first node to the second node using the second protocol.

41. A computer program product for transferring signaling data within a network, the computer program product comprising:

first instructions for receiving a message for transfer to a node, wherein the message is received using a first protocol;
second instructions for placing the message in a data packet using a second protocol to create the data packet;
third instructions for placing routing information into the data packet, wherein the routing information is used by the first protocol for processing of the packet at the node;
fourth instructions for establishing a connection to the node, wherein the connection uses the second protocol to send data packets; and
fifth instructions for sending the data packet to the node through the connection.


100
110
SS7
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NETWORK
104
GATEWAY
IP
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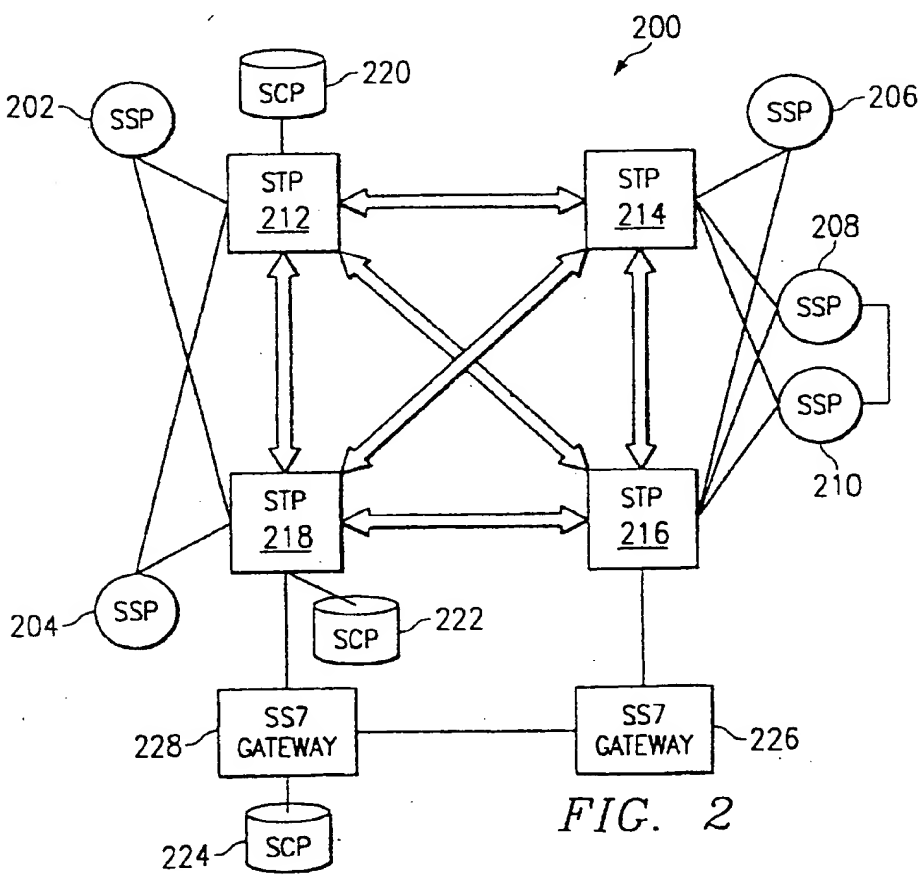
102
SS7
SIGNALING
NETWORK
106

FIG. 1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STP
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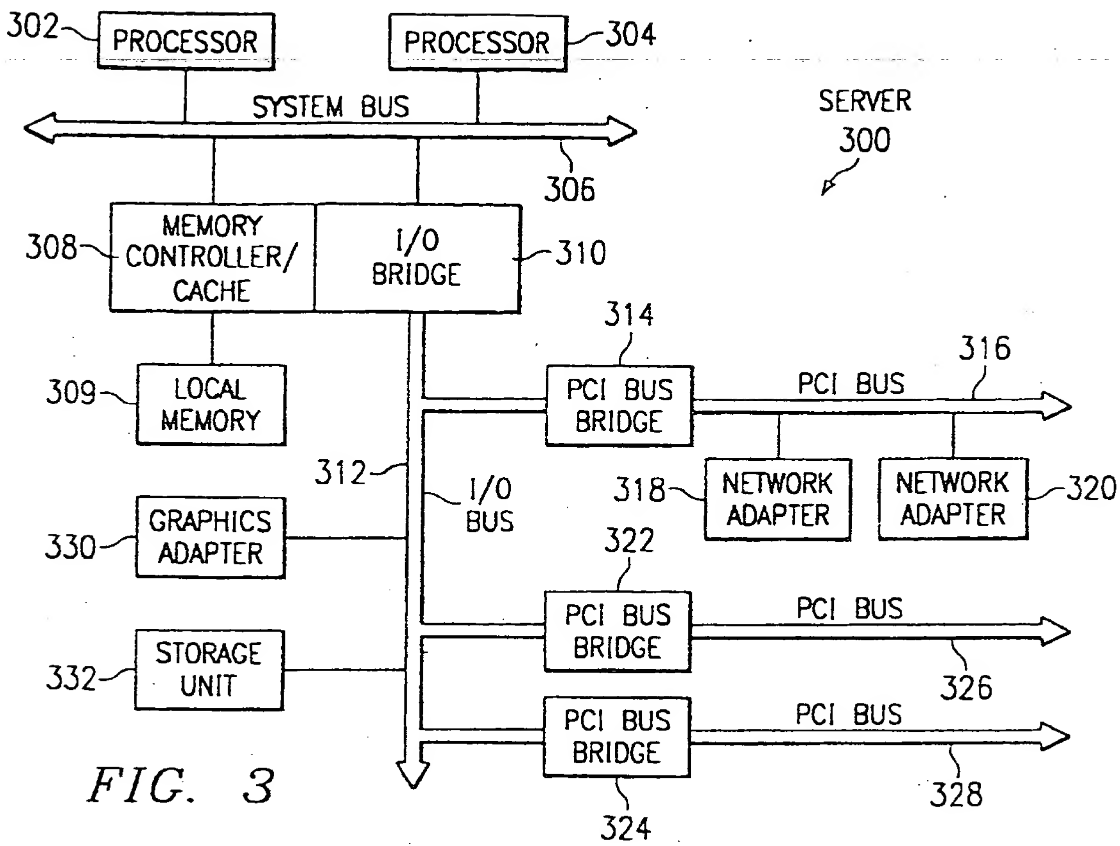
226
224
SCP

FIG. 2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304
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SERVER
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306
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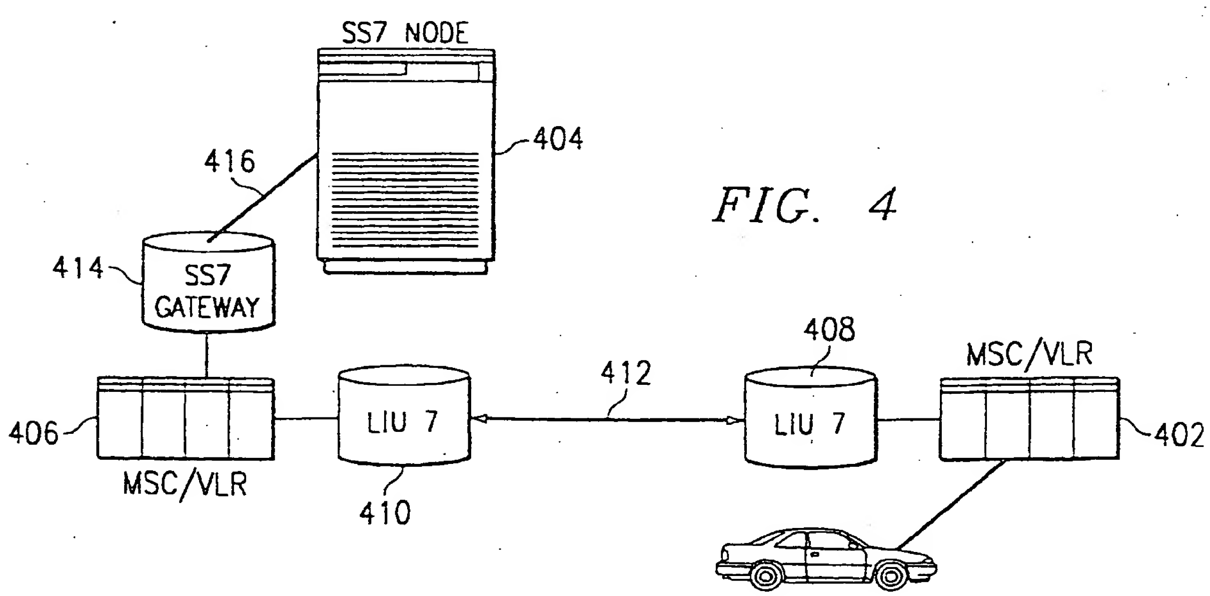
I/O BRIDGE
310
314
316
309
LOCAL MEMORY
PCI BUS BRIDGE
PCI BUS
312
I/O BUS
318
NETWORK ADAPTER
NETWORK ADAPTER
320
330
GRAPHICS ADAPTER
322
PCI BUS BRIDGE
PCI BUS
326
332
STORAGE UNIT
PCI BUS BRIDGE
PCI BUS
328
324

FIG. 3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416
414
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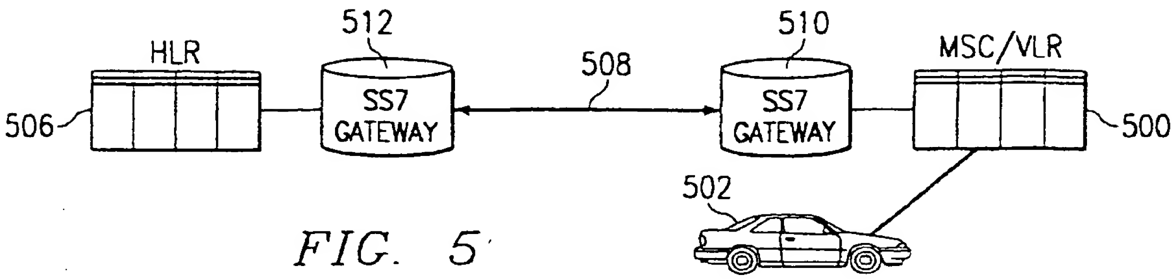
408
MSC/VLR
412
406
MSC/VLR
LIU 7
LIU 7
402
410

FIG. 4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HLR
508
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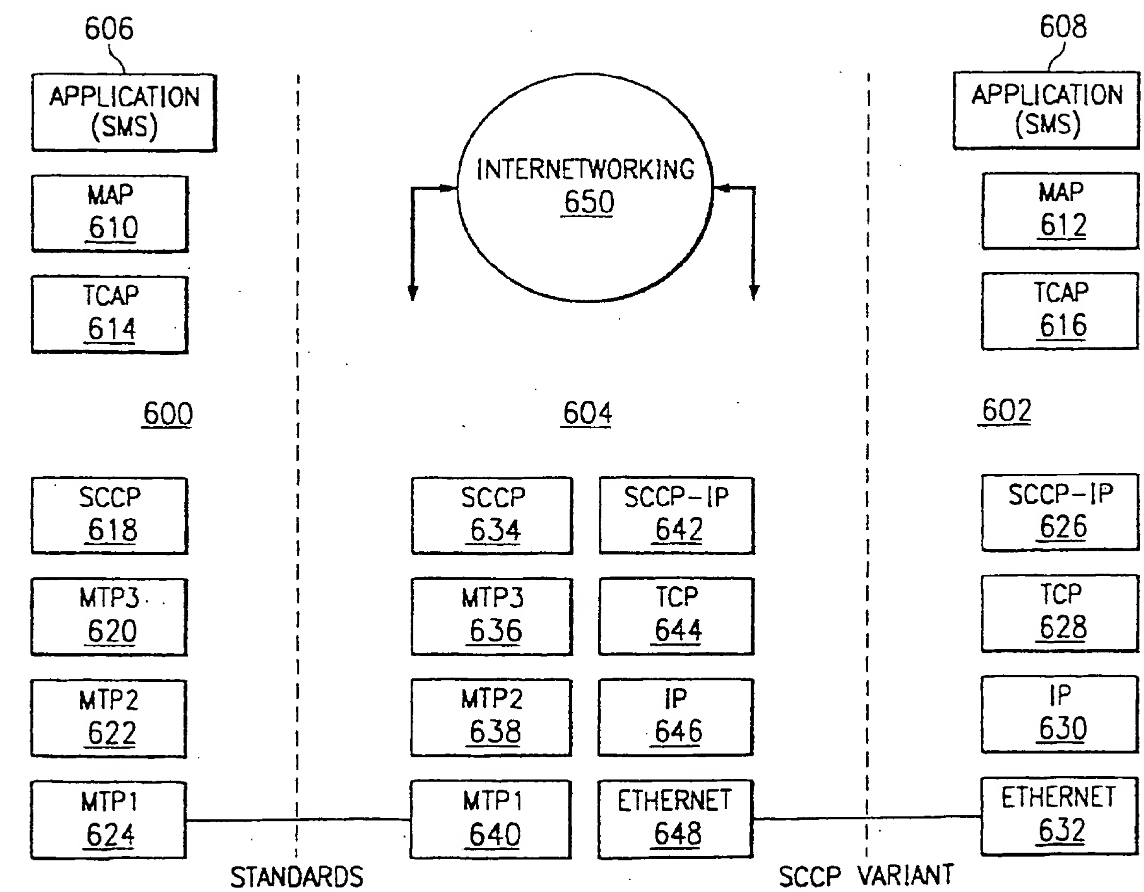
GATEWAY
506
500
502

FIG. 5


606
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APPLICATION
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MAP
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MAP
612
TCAP
614
TCAP
616
600
604
602
SCCP
618
SCCP
634
SCCP-IP
642
SCCP-IP
626
MTP3
620
MTP3
636
TCP
644
TCP
628
MTP2
622
MTP2
638
IP
646
IP
630
MTP1
624
MTP1
640
ETHERNET
648
ETHERNET
632
STANDARDS
SCCP VARIANT

FIG. 6

FIG. 7

	Field Name	Length (Bytes)	Description	Default Value	Range	Remarks
800	Field Name	Length (Bytes)	Description	Default Value	Range	Remarks
802	Network type	1	Target Network (IS41, GSM, etc.)	0	1=IS41 2=GSM 0=Test	All other values are reserved. Test message is used for debugging purposes only and only protocol version field is valid.
804	Protocol Version	1	Implementation of protocol between gateway and application		1.0 to 10.10	BCD encoded major and minor version identifiers
806	UDT Data Format	1	UDT data format for decoding messages	0	0=ITU-T 1=ANSI 2=NTC	All other values are reserved
808	Sequence Control	1	Indicates whether the use of SLS is required	-	-	Advisory parameter specified by the client node for data transfer in SS7 network to the SS7 gateway
810	SCCP Class	1	SCCP class information. Refer to Q.711 for further information	0	-	To decode the message and create a message for forwarding to SS7 network
812	Return Info	1	SCCP Return Option or Reason	0	-	As defined by Q.711
814	Called Party Address	10	SCCP called party address or destination address	0	-	Refer to SCCP addressing scheme. MS byte is reserved
816	Calling Party Address	10	SCCP calling party address or originating address	0	-	Refer to SCCP addressing scheme. MS byte is reserved
818	Spare	6	-	-	-	-
820	Data Length	2	Data length of the payload	0	0-2^32	The size of payload

FIG. 8

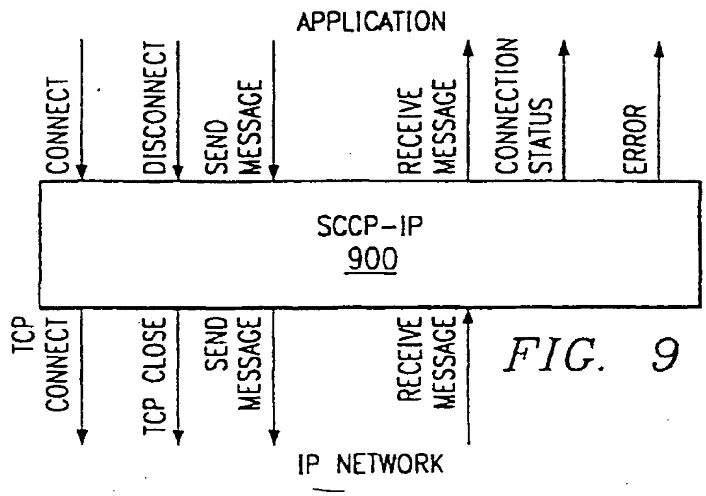


FIG. 9

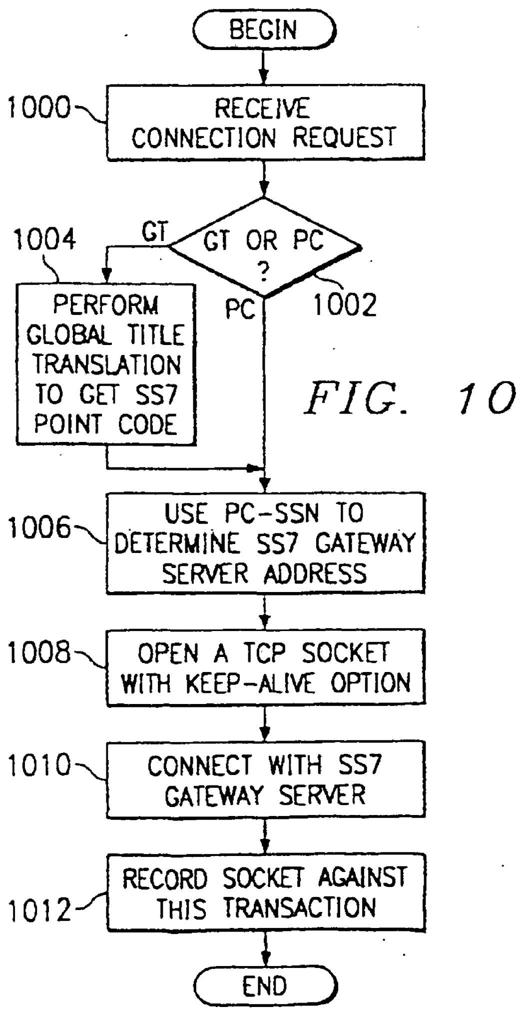


FIG. 10

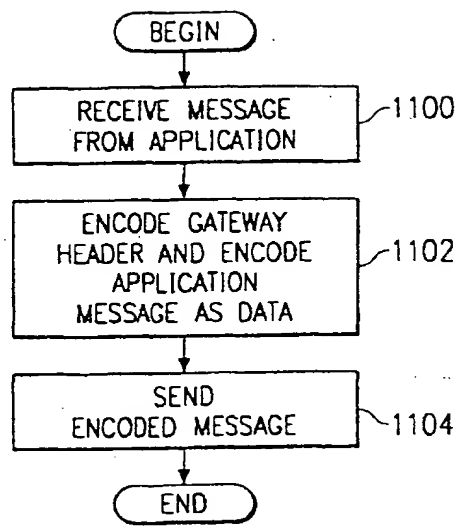


FIG. 11

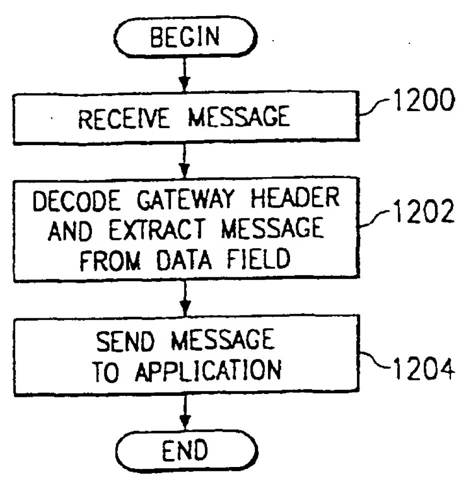


FIG. 12

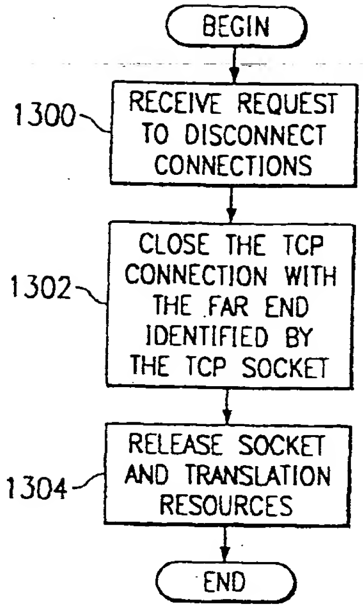


FIG. 13

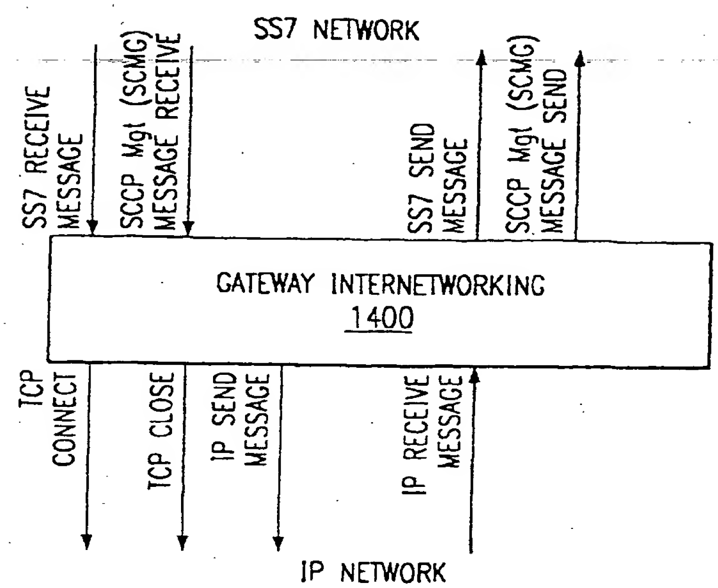


FIG. 14

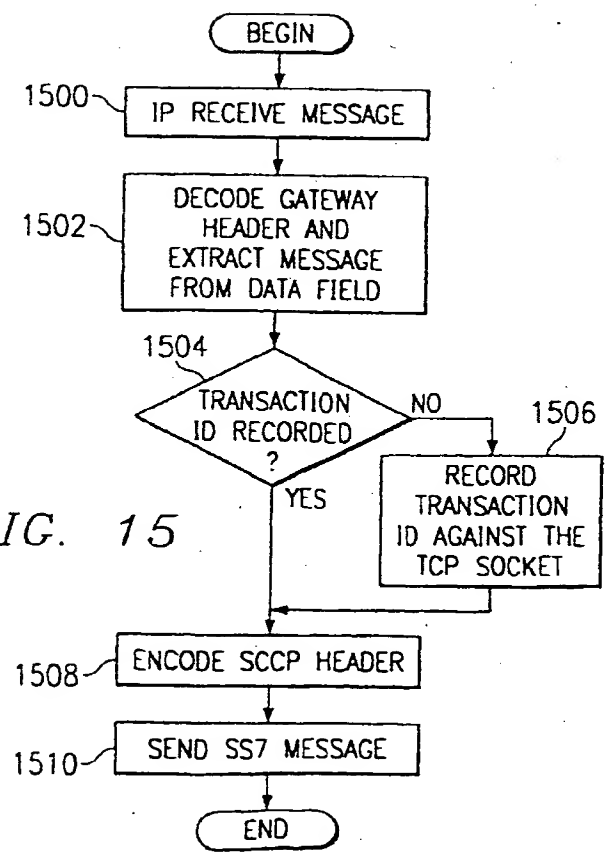
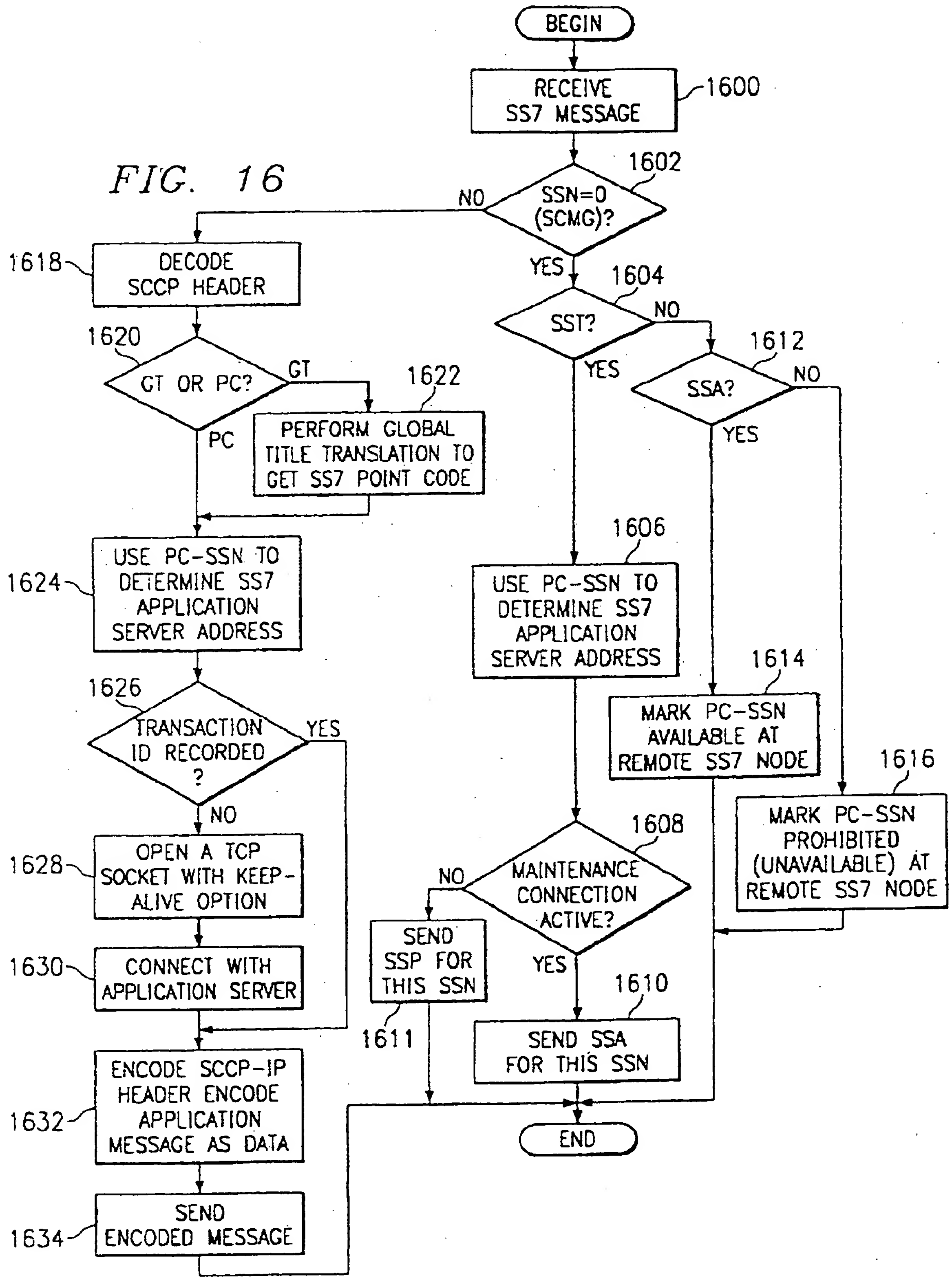


FIG. 15

FIG. 16


BEGIN
RECEIVE SS7 MESSAGE
1600
1602
SSN=0 (SCMG)?
NO
YES
1604
SST?
NO
YES
1612
SSA?
NO
YES
1618
DECODE SCCP HEADER
1620
GT OR PC?
GT
PC
1622
PERFORM GLOBAL TITLE TRANSLATION TO GET SS7 POINT CODE
1624
USE PC-SSN TO DETERMINE SS7 APPLICATION SERVER ADDRESS
1626
TRANSACTION ID RECORDED ?
YES
NO
1628
OPEN A TCP SOCKET WITH KEEP-ALIVE OPTION
1630
CONNECT WITH APPLICATION SERVER
1632
ENCODE SCCP-IP HEADER ENCODE APPLICATION MESSAGE AS DATA
1634
SEND ENCODED MESSAGE
1606
USE PC-SSN TO DETERMINE SS7 APPLICATION SERVER ADDRESS
1614
MARK PC-SSN AVAILABLE AT REMOTE SS7 NODE
1616
MARK PC-SSN PROHIBITED (UNAVAILABLE) AT REMOTE SS7 NODE
1608
MAINTENANCE CONNECTION ACTIVE?
NO
YES
SEND SSP FOR THIS SSN
1611
1610
SEND SSA FOR THIS SSN
END

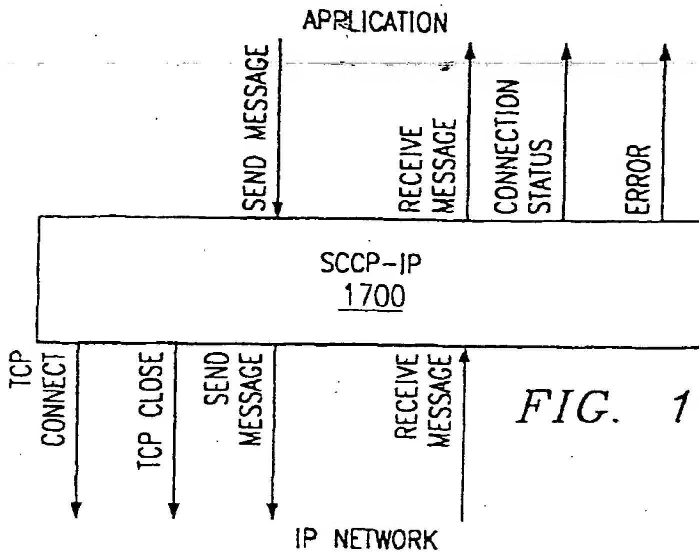


FIG. 17

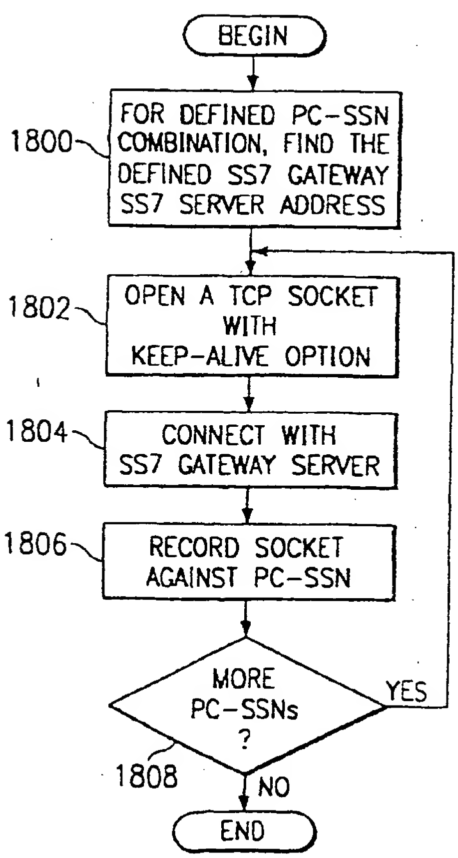


FIG. 18

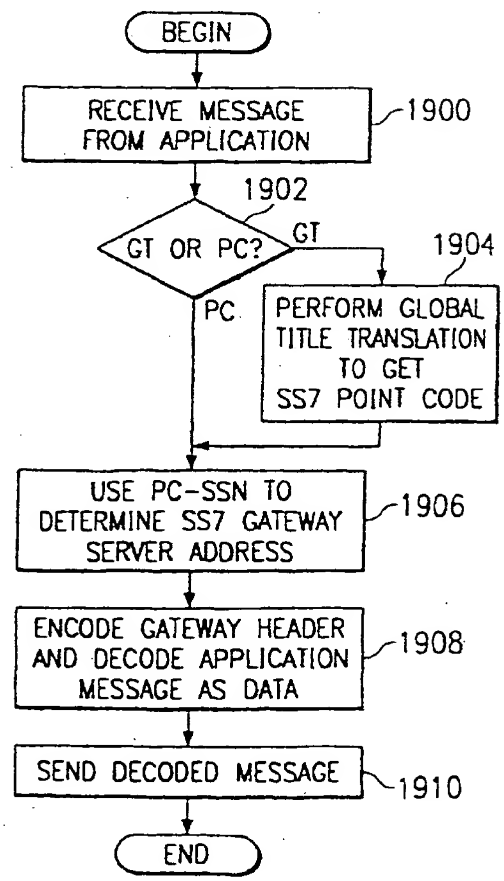


FIG. 19

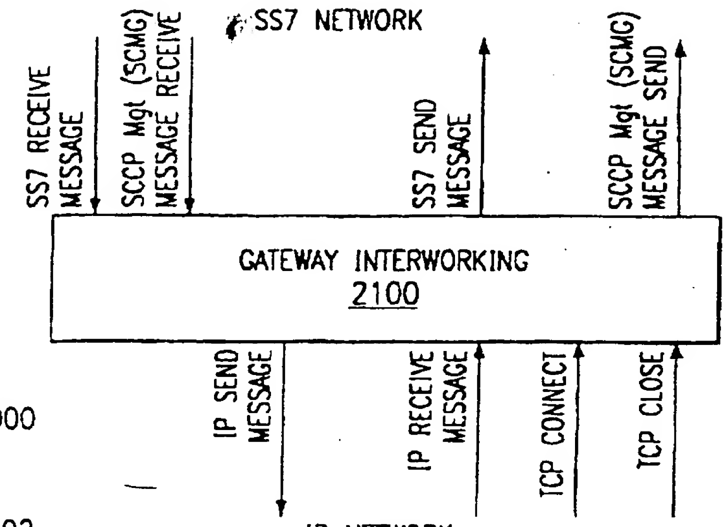


FIG. 21

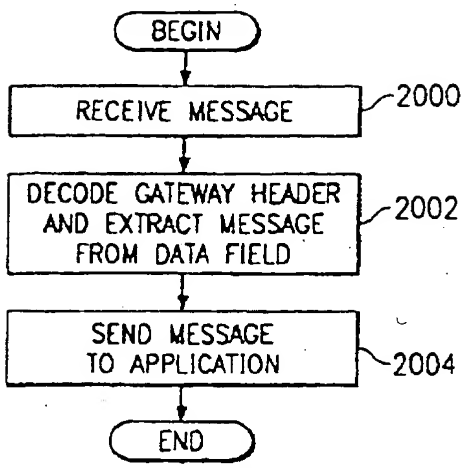


FIG. 20

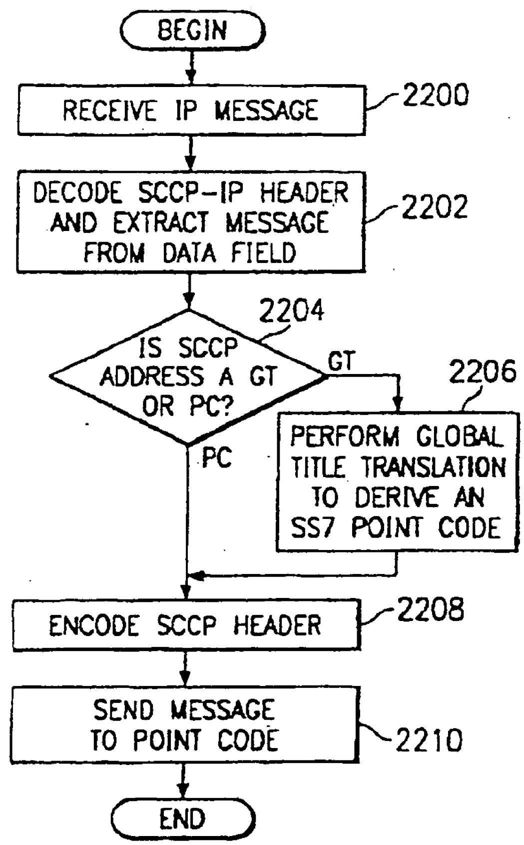


FIG. 22

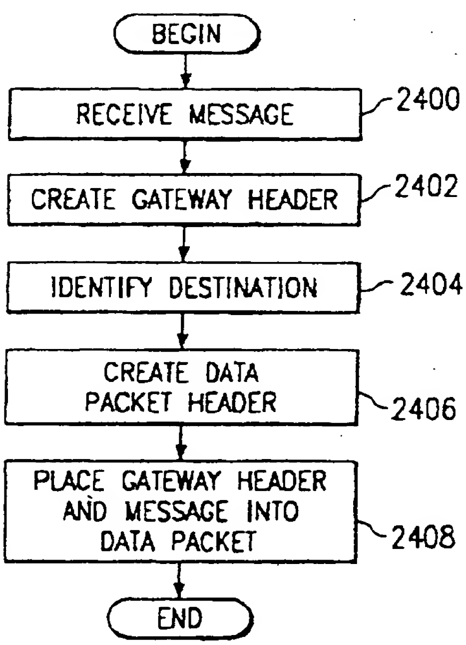


FIG. 24

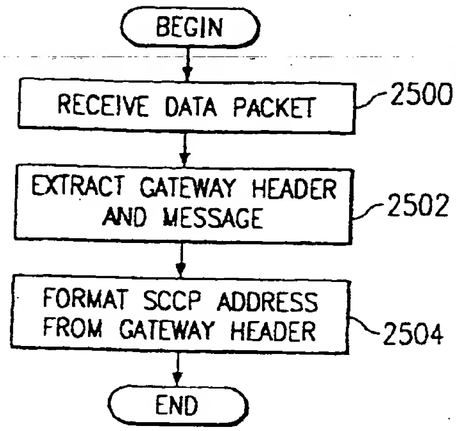

BEGIN
RECEIVE DATA PACKET
2500
EXTRACT GATEWAY HEADER AND MESSAGE
2502
FORMAT SCCP ADDRESS FROM GATEWAY HEADER
2504
END

FIG. 25

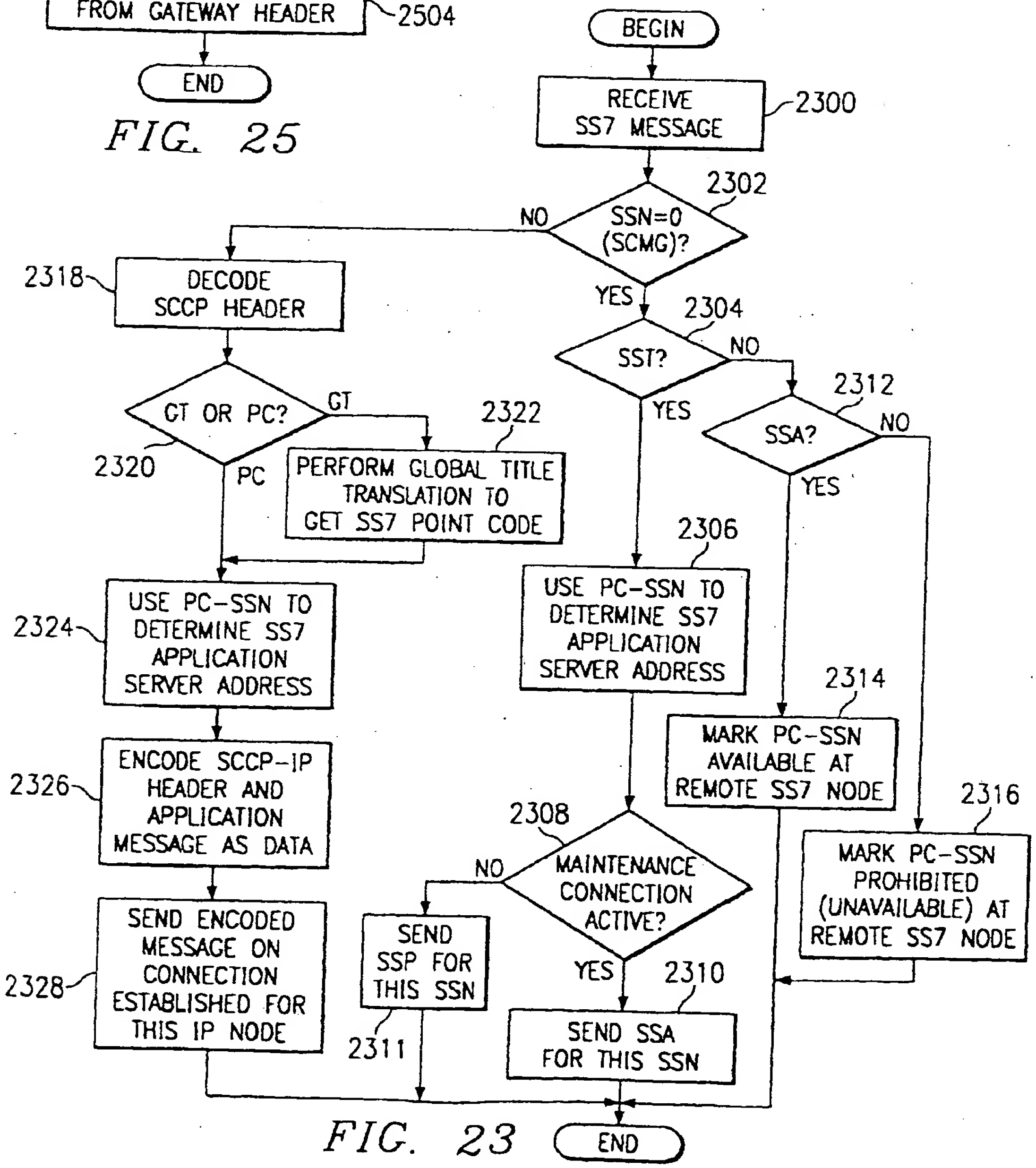

BEGIN
RECEIVE SS7 MESSAGE
2300
2302
SSN=0 (SCMG)?
NO
YES
2318
DECODE SCCP HEADER
2304
SST?
NO
YES
2312
SSA?
NO
YES
GT OR PC?
GT
PC
2320
2322
PERFORM GLOBAL TITLE TRANSLATION TO GET SS7 POINT CODE
2306
USE PC-SSN TO DETERMINE SS7 APPLICATION SERVER ADDRESS
2324
USE PC-SSN TO DETERMINE SS7 APPLICATION SERVER ADDRESS
2314
MARK PC-SSN AVAILABLE AT REMOTE SS7 NODE
2316
MARK PC-SSN PROHIBITED (UNAVAILABLE) AT REMOTE SS7 NODE
2326
ENCODE SCCP-IP HEADER AND APPLICATION MESSAGE AS DATA
2308
MAINTENANCE CONNECTION ACTIVE?
NO
YES
SEND SSP FOR THIS SSN
2311
2310
SEND SSA FOR THIS SSN
2328
SEND ENCODED MESSAGE ON CONNECTION ESTABLISHED FOR THIS IP NODE
END

FIG. 23